Young Neutron Stars and Their Environments
IAU Symposium, Vol. 218, 2004
F. Camilo and B. M. Gaensler, eds.

H I Study of Southern Galactic Supernova Remnants

Bon-Chul Koo and Ji-hyun Kang

SEES, Seoul National University, Seoul 151-742, Korea

Naomi McClure-Griffiths

ATNF-CSIRO, PO Box 76, Epping NSW 1710, Australia

Abstract. We briefly summarize the survey of H I 21 cm emission lines to search for shocked atomic gas associated with Galactic supernova remnants (SNRs) in the southern sky. For G347.3−0.5, we discuss the distance to the SNR and the implications of the H I results.

1. The Survey

We carried out a H I 21-cm line survey to search for shocked atomic gas associated with Galactic SNRs in the southern sky. We have studied 97 SNRs between $\ell = 253^\circ$–358° in the Green's catalog using the Southern Galactic Plane Survey (SGPS) data. We compare the average H I spectra of SNRs to those of the surrounding regions, and look for excessive emission wider than 10 km s^{-1} and localized at the position of the SNRs. We divide the SNRs into 3 ranks, where the increasing number implies increasing reliability of a detected H I feature. The ranks correspond to those of Koo & Heiles (1991), who did a similar survey toward the northern SNRs. Of the 97 SNRs, 10 SNRs are ranked as 3, 22 SNRs are ranked as 2, and others are ranked as 1. Rank 3 SNRs have very high-velocity H I gas confined to the SNR, and the association is quite plausible.

2. G347.3−0.5

G347.3−0.5 (RX J1713.7−3946) is one of the rank 3 SNRs. It is a shell-type SNR with X-rays dominated by non-thermal synchrotron radiation like SN 1006. TeV gamma-ray emission has been detected toward the X-ray bright western shell (Muraishi et al. 2000). There are two different interpretations for G347.3−0.5: (1) it is a young SNR at a distance of 1 kpc, possibly the remnant of the SN AD 393 (Koyama et al. 1997), and (2) it is an old SNR at a distance of 6 kpc, possibly interacting with molecular clouds (Slane et al. 1999).

Fig. 1 (left) shows average H I and CO profiles toward the direction of the SNR. The H I profile is obtained from the SGPS data while the CO profile is from the CfA CO survey (Dame et al. 2001). The total H I column density along the line of sight is $(1.8$–$2.3)\times10^{22}$ cm^{-2} assuming a constant spin temperature of 130–200 K. The total column density of H_2 molecules, using $N(\mathrm{H_2})/I(\mathrm{CO}) = 1.9\times10^{20}\mathrm{cm}^{-2}$ (K km s$^{-1})^{-1}$, is $\simeq 0.4\times10^{22}$ cm^{-2}. Hence, the total column

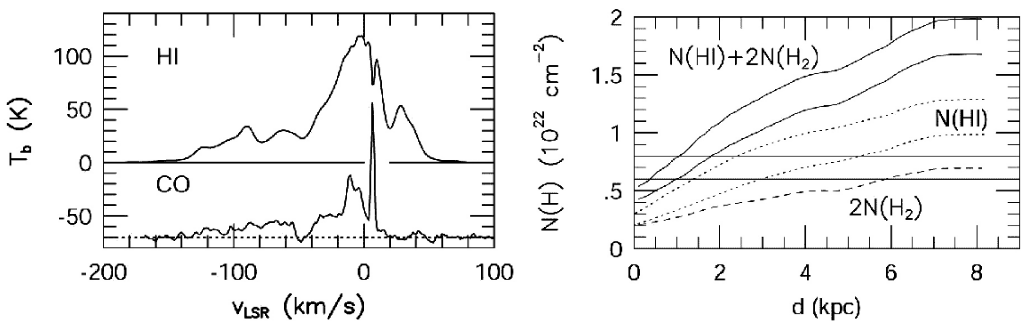

Figure 1. (left) HI and CO (J=1–0) profiles toward the SNR. The peak intensity of the CO emission is 1.3 K. (right) Hydrogen column density as a function of distance toward the direction of G347.3−0.5. For N(HI) (and $N(\mathrm{HI}) + 2N(\mathrm{H_2})$), the upper and lower graphs correspond to spin temperatures of 130 K and 200 K, respectively.

density of H nuclei is $(2.6 - 3.1) \times 10^{22}$ cm^{-2}, which is considerably greater than the X-ray absorbing columns ($\simeq$ 0.6–0.8 $\times$ 10^{22} cm^{-2} Slane et al. 1999). Fig. 1 (right) shows how the column densities vary as a function of distance, which was obtained by converting the LSR velocity to distance assuming a flat Galactic rotation model. There is a distance ambiguity, and we arbitrarily assumed that 2/3 (1/3) of the column density at a given velocity is from the gas on the near (far) side. We also assumed that 2/3 of the HI emission between $v_{\mathrm{LSR}} = 0$ and +10 km s^{-1} is from the local gas, while all the H_2 emission in this velocity range is assumed to be from the local gas because there is a self-absorption HI feature associated with the molecular gas. According to Fig. 1 (right), the distance at which the accumulative column density equals the X-ray absorbing columns is $\sim$ 1 kpc.

The excess HI emission toward G347.3−0.5 is detected between $v_{\mathrm{LSR}} = 68$ and 81 km s^{-1} at the western rim where the X-rays are enhanced. At a distance of 1 kpc, the radius (30′) of the SNR is 9 pc and the detection of shock-accelerated HI gas implies an interaction with a dense medium. Previous studies showed that the fast-moving HI gas is often produced by SNR shocks propagating through molecular clouds, and G3473.−0.5 may interact with molecular clouds too.

Acknowledgments. This work was supported by S.N.U. Research Fund (3345-20022017).

References

Dame, T. M., Hartmann, D., & Thaddeus, P. 2001, ApJ, 547, 792

Koo, B.-C., & Heiles, C. 1991, ApJ, 382, 204

Koyama, K. et al. 1997, PASJ, 49, L7

Muraishi et al. 2000, A&A, 354, L57

Slane, P. et al. 1999, ApJ, 525, 357